ATMOSPHERIC AND OCEANIC SCIENCES, BA

The study of atmospheric and oceanic sciences includes all aspects of the atmosphere and physical oceanography, their mutual interaction, and their interaction with space and the rest of the earth system. Although a primary goal is to understand the atmosphere and ocean for the purpose of predicting the weather, atmospheric and oceanic sciences embraces much more: motions at large, medium, and small scales; past, present, and future climates; air chemistry and quality; clouds and precipitation; and solar and terrestrial radiation. In many areas, new remote-sensing technology including satellites is used to provide circulation patterns at both global and local scales.

Many undergraduates take an elementary atmospheric and oceanic sciences course to meet part of their natural or physical science breadth requirements. Other students, who have had sufficient mathematics and physics preparation, take higher-level atmospheric and oceanic sciences courses to complement their major work in other fields of natural science. An atmospheric and oceanic sciences major receives a thorough introduction to the basic concepts and tools in the core courses, which cover the physics and dynamics of the atmosphere and ocean. An array of elective courses are offered in the senior year, with tracks in the areas of weather systems, earth/environmental science, and general and applied atmospheric and oceanic sciences. Elective groups are tailored individually. Some students will want preparation for careers in areas such as operational forecasting, environmental consulting, and broadcasting. Others will seek preparation for graduate work leading to a broader range of careers.

HOW TO GET IN

HOW TO GET IN

There are no admissions requirements for the major. Students wishing to declare the Atmospheric & Oceanic Sciences major should meet with the Undergraduate Academic Advising Manager listed in the Contact Box on the right sidebar of this page.

REQUIREMENTS

UNIVERSITY GENERAL EDUCATION REQUIREMENTS

All undergraduate students at the University of Wisconsin–Madison are required to fulfill a minimum set of common university general education requirements to ensure that every graduate acquires the essential core of an undergraduate education. This core establishes a foundation for living a productive life, being a citizen of the world, appreciating aesthetic values, and engaging in lifelong learning in a continually changing world. Various schools and colleges will have requirements in addition to the requirements listed below. Consult your advisor for assistance, as needed. For additional information, see the university Undergraduate General Education Requirements (http://guide.wisc.edu/undergraduate/#requirementsforundergraduatestudytext) section of the *Guide*.

General Education	• Breadth—Humanities/Literature/Arts: 6 credits • Breadth—Natural Science: 4 to 6 credits, consisting of one 4- or 5-credit course with a laboratory component; or two courses providing a total of 6 credits • Breadth—Social Studies: 3 credits • Communication Part A & Part B * • Ethnic Studies * • Quantitative Reasoning Part A & Part B *

* The mortarboard symbol appears before the title of any course that fulfills one of the Communication Part A or Part B, Ethnic Studies, or Quantitative Reasoning Part A or Part B requirements.

COLLEGE OF LETTERS & SCIENCE DEGREE REQUIREMENTS: BACHELOR OF ARTS (BA)

Students pursuing a bachelor of arts degree in the College of Letters & Science must complete all of the requirements below. The College of Letters & Science allows this major to be paired with either a bachelor of arts or a bachelor of science curriculum.

BACHELOR OF ARTS DEGREE REQUIREMENTS

Mathematics	Complete the University General Education Requirements for Quantitative Reasoning A (QR-A) and Quantitative Reasoning B (QR-B) coursework.
Language	• Complete the fourth unit of a language other than English; OR • Complete the third unit of a language and the second unit of an additional language other than English.
L&S Breadth	• 12 credits of Humanities, which must include 6 credits of literature; and • 12 credits of Social Science; and • 12 credits of Natural Science, which must include one 3+ credit Biological Science course and one 3+ credit Physical Science course.
Liberal Arts and Science Coursework	Complete at least 108 credits.
Depth of Intermediate/Advanced work	Complete at least 60 credits at the intermediate or advanced level.
Major	Declare and complete at least one major.
Total Credits	Complete at least 120 credits.
UW-Madison Experience	• 30 credits in residence, overall; and • 30 credits in residence after the 86th credit.

Quality of Work	• 2.000 in all coursework at UW–Madison • 2.000 in Intermediate/Advanced level coursework at UW–Madison

NON–L&S STUDENTS PURSUING AN L&S MAJOR

Non–L&S students who have permission from their school/college to pursue an additional major within L&S only need to fulfill the major requirements. They do not need to complete the L&S Degree Requirements above.

REQUIREMENTS FOR THE MAJOR

Code	Title	Credits
Calculus (complete all):		
MATH 221	Calculus and Analytic Geometry 1	5
MATH 222	Calculus and Analytic Geometry 2	4
MATH 234	Calculus--Functions of Several Variables	4
Physics (complete one course from each group):		
PHYSICS 207	General Physics	5
or PHYSICS 201	General Physics	
or PHYSICS 247	A Modern Introduction to Physics	
PHYSICS 208	General Physics	5
or PHYSICS 202	General Physics	
or PHYSICS 248	A Modern Introduction to Physics	
Computer Sciences (complete one):		**3**
COMP SCI 220	Data Science Programming I	
COMP SCI 310	Problem Solving Using Computers	
COMP SCI 320	Data Science Programming II	
COMP SCI/ E C E 354	Machine Organization and Programming	
COMP SCI 412	Introduction to Numerical Methods	
COMP SCI/I SY E/ MATH 425	Introduction to Combinatorial Optimization	
Total Credits		**26**

Code	Title	Credits
Core Sequence (complete all):		
ATM OCN 310	Dynamics of the Atmosphere and Ocean I	3
ATM OCN 311	Dynamics of the Atmosphere and Ocean II	3
ATM OCN 330	Physics of the Atmosphere and Ocean I	3
ATM OCN 340	Physics of the Atmosphere and Ocean II	3
Quantitative Analysis (complete one):		**3**
COMP SCI 412	Introduction to Numerical Methods	
COMP SCI/ MATH/STAT 475	Introduction to Combinatorics	
COMP SCI/ MATH 514	Numerical Analysis	
COMP SCI/I SY E/ MATH/STAT 525	Linear Optimization	

Code	Title
MATH/STAT 309	Introduction to Probability and Mathematical Statistics I
MATH/STAT 310	Introduction to Probability and Mathematical Statistics II
MATH 319	Techniques in Ordinary Differential Equations
MATH 320	Linear Algebra and Differential Equations
MATH 321	Applied Mathematical Analysis
MATH 322	Applied Mathematical Analysis
MATH 331	Introductory Probability
MATH 340	Elementary Matrix and Linear Algebra
MATH 341	Linear Algebra
MATH 375	Topics in Multi-Variable Calculus and Linear Algebra
MATH 376	Topics in Multi-Variable Calculus and Differential Equations
MATH 407	Topics in Mathematics Study Abroad
MATH 415	Applied Dynamical Systems, Chaos and Modeling
MATH 421	The Theory of Single Variable Calculus
MATH/ COMP SCI/ I SY E 425	Introduction to Combinatorial Optimization
MATH/STAT 431	Introduction to the Theory of Probability
MATH/ COMP SCI/ E C E 435	Introduction to Cryptography
MATH 441	
MATH 443	Applied Linear Algebra
MATH 461	College Geometry I
MATH 467	Introduction to Number Theory
MATH/ CURRIC 471	Mathematics for Secondary School Teachers
MATH/ HIST SCI 473	History of Mathematics
MATH/ COMP SCI/ STAT 475	Introduction to Combinatorics
MATH 490	Undergraduate Seminar
MATH 491	Topics in Undergraduate Mathematics
MATH/ COMP SCI 513	Numerical Linear Algebra
MATH/ COMP SCI 514	Numerical Analysis
MATH 519	Ordinary Differential Equations
MATH 521	Analysis I
MATH 522	Analysis II
MATH/ COMP SCI/I SY E/ STAT 525	Linear Optimization
MATH 531	Probability Theory

MATH 535	Mathematical Methods in Data Science
MATH 540	Linear Algebra II
MATH 541	Modern Algebra
MATH 542	Modern Algebra
MATH 551	Elementary Topology
MATH 552	Elementary Geometric and Algebraic Topology
MATH 561	Differential Geometry
MATH 567	Modern Number Theory
MATH 570	Fundamentals of Set Theory
MATH/ PHILOS 571	Mathematical Logic
MATH 605	
MATH 607	Topics in Mathematics Study Abroad
MATH/B M I/ BIOCHEM/ BMOLCHEM 609	Mathematical Methods for Systems Biology
MATH 619	Analysis of Partial Differential Equations
MATH 621	Introduction to Manifolds
MATH 623	Complex Analysis
MATH 627	Introduction to Fourier Analysis
MATH 629	Introduction to Measure and Integration
MATH/I SY E/ OTM/STAT 632	Introduction to Stochastic Processes
STAT/MATH 309	Introduction to Probability and Mathematical Statistics I
STAT/MATH 310	Introduction to Probability and Mathematical Statistics II
STAT 311	Introduction to Theory and Methods of Mathematical Statistics I
STAT 312	Introduction to Theory and Methods of Mathematical Statistics II
STAT 324	Introductory Applied Statistics for Engineers
STAT 333	Applied Regression Analysis
STAT 340	Data Science Modeling II
STAT 349	Introduction to Time Series
STAT 351	Introductory Nonparametric Statistics
STAT 360	Topics in Statistics Study Abroad
STAT 371	Introductory Applied Statistics for the Life Sciences
STAT 411	An Introduction to Sample Survey Theory and Methods
STAT 421	Applied Categorical Data Analysis
STAT/M E 424	Statistical Experimental Design
STAT/MATH 431	Introduction to the Theory of Probability
STAT 456	Applied Multivariate Analysis
STAT 461	Financial Statistics
STAT/ COMP SCI 471	Introduction to Computational Statistics

STAT/COMP SCI/ MATH 475	Introduction to Combinatorics	
STAT 479	Special Topics in Statistics	
STAT/COMP SCI/ I SY E/MATH 525	Linear Optimization	
STAT/B M I 541	Introduction to Biostatistics	
STAT/B M I 542	Introduction to Clinical Trials I	
STAT/ F&W ECOL 571	Statistical Methods for Bioscience I	
STAT/ F&W ECOL 572	Statistical Methods for Bioscience II	
STAT 575	Statistical Methods for Spatial Data	
STAT 601	Statistical Methods I	
STAT 602	Statistical Methods II	
STAT 605	Data Science Computing Project	
STAT 609	Mathematical Statistics I	
STAT 610	Introduction to Statistical Inference	
STAT 615	Statistical Learning	
STAT 627	Professional Skills in Data Science	
STAT 628	Data Science Practicum	
STAT/I SY E/ MATH/OTM 632	Introduction to Stochastic Processes	
STAT/B M I 641	Statistical Methods for Clinical Trials	
STAT/B M I 642	Statistical Methods for Epidemiology	
STAT 679	Special Topics in Statistics	
STAT 681	Senior Honors Thesis	
STAT 682	Senior Honors Thesis	
Capstone		
ATM OCN 405	AOS Senior Capstone Seminar	1
Electives		**11**
ATM OCN 401	Topics in Meteorology	
ATM OCN 404	Meteorological Measurements	
ATM OCN 425	Global Climate Processes	
ATM OCN 441	Radar and Satellite Meteorology	
ATM OCN 452	Synoptic Laboratory I: The Frontal Cyclone	
ATM OCN 453	Synoptic Laboratory II: Mesoscale Meteorology	
ATM OCN/ ENVIR ST 520	Bioclimatology	
ATM OCN 522	Tropical Meteorology	
ATM OCN/ AGRONOMY/ SOIL SCI 532	Environmental Biophysics	
ATM OCN 535		
ATM OCN 573	Computational Methods in Atmospheric and Oceanic Sciences	
ATM OCN 575	Climatological Analysis	
ATM OCN 610	Geophysical Fluid Dynamics I	
ATM OCN 611	Geophysical Fluid Dynamics II	
ATM OCN 615		
ATM OCN 630	Introduction to Atmospheric and Oceanic Physics	

ATM OCN 637	Cloud Physics	
ATM OCN 638		
ATM OCN 640	Radiation in the Atmosphere and Ocean	
ATM OCN 651		
ATM OCN 660	Introduction to Physical Oceanography	
ATM OCN 681	Senior Honors Thesis	
ATM OCN 682	Senior Honors Thesis	
ATM OCN 691	Senior Thesis	
ATM OCN 692	Senior Thesis	
ATM OCN 698	Directed Study [2]	
ATM OCN 699	Directed Study [2]	
Total Credits		**27**

RESIDENCE AND QUALITY OF WORK

- 2.000 GPA in all ATM OCN and major courses
- 2.000 GPA on 15 upper-level credits in the major, taken in Residence. [3]
- 15 credits in ATM OCN, taken on campus

HONORS IN THE MAJOR

Students may declare Honors in the Atmospheric and Oceanic Sciences Major in consultation with the Atmospheric and Oceanic Sciences undergraduate advisor.

REQUIREMENTS

To earn Honors in the Major in Atmospheric and Oceanic Sciences, students must satisfy both the requirements for the major (above) and the following additional requirements:

- Earn a 3.300 University GPA
- Earn a 3.400 GPA for all ATM OCN courses, and all courses accepted in the major
- Complete the following additional coursework:
  - ATM OCN 610 or ATM OCN 611 and
  - ATM OCN 681 and ATM OCN 682 for a total of 6 credits

FOOTNOTES

[1] Note that core sequence begins in the fall semester only.
[2] A maximum 2 credits of Electives may come from Internship or Directed Study courses.
[3] ATM OCN 300 through ATM OCN 699 are upper-level in the major.

UNIVERSITY DEGREE REQUIREMENTS

Total Degree   To receive a bachelor's degree from UW–Madison, students must earn a minimum of 120 degree credits. The requirements for some programs may exceed 120 degree credits. Students should consult with their college or department advisor for information on specific credit requirements.

Residency   Degree candidates are required to earn a minimum of 30 credits in residence at UW–Madison. "In residence" means on the UW–Madison campus with an undergraduate degree classification. "In residence" credit also includes UW–Madison courses offered in distance or online formats and credits earned in UW–Madison Study Abroad/Study Away programs.

Quality of Work   Undergraduate students must maintain the minimum grade point average specified by the school, college, or academic program to remain in good academic standing. Students whose academic performance drops below these minimum thresholds will be placed on academic probation.

LEARNING OUTCOMES

LEARNING OUTCOMES

1. Recognize and describe the fundamental principles and processes associated with the dynamics and thermodynamics of geophysical fluid flows, the basic physics of clouds, aerosols, and precipitation.
2. Recognize and describe the fundamental principles and processes associated with radiation and atmospheric and oceanic radiative transfer.
3. Demonstrate critical thinking skills by identifying a problem, identifying the required information to solve that problem; and formulating and interpreting solutions to that problem using appropriate analytical and/or computational techniques.
4. Apply diagnostic tools to to analyses and numerical model output to diagnose, describe, and interpret the fundamental dynamical and thermodynamical processes at work in synoptic-scale, mesoscale, and large-scale weather systems and climate circulations.
5. Apply fundamental radiative transfer theory to interpret remotely-sensed observations of atmospheric and oceanic phenomena.
6. Design and conduct experiments and/or analyze data to test hypotheses in an area of atmospheric or climate sciences.
7. Demonstrate effective scientific communication skills through development and delivery of oral presentations (including poster presentations) and written reports and case studies.

FOUR-YEAR PLAN

FOUR-YEAR PLAN

This Four-Year Plan is only one way a student may complete an L&S degree with this major. Many factors can affect student degree planning, including placement scores, credit for transferred courses, credits earned by examination, and individual scholarly interests. In addition, many students have commitments (e.g., athletics, honors, research, student organizations, study abroad, work and volunteer experiences) that necessitate they adjust their plans accordingly. Informed students engage in their own unique Wisconsin Experience by consulting their academic advisors, Guide, DARS, and Course Search & Enroll for assistance making and adjusting their plan.

First Year

Fall	Credits	Spring	Credits
MATH 221 (QR-B)	5	MATH 222	4
ATM OCN 100 or 101	4	ATM OCN/ENVIR ST 171 (Comm B)	3

Communication A	3	Literature Breadth	3
Foreign Language	4	Biological Science Breadth	3
	16		**13**

Second Year

Fall	Credits	Spring	Credits
MATH 234	4	Humanities Breadth	3
PHYSICS 207	5	PHYSICS 208	5
Biological Science Breadth	3	COMP SCI 220	4
Ethnic Studies	4	Social Science Breadth	3
	16		**15**

Third Year

Fall	Credits	Spring	Credits
ATM OCN 310	3	ATM OCN 311	3
ATM OCN 330	3	ATM OCN 340	3
Literature Breadth	3	Biological Science Breadth	3
ADV MATH/COMP SCI/STATS	3	Humanities Breadth	3
Social Science Breadth	4	Elective	3
	16		**15**

Fourth Year

Fall	Credits	Spring	Credits
ATM OCN 400 or higher	3	ATM OCN numbered 400 or higher	3
ATM OCN 400 or higher	4	ATM OCN numbered 400 level or higher	4
Elective	4	ATM OCN 699 (or elective)	3
Social Science Breadth	4	ATM OCN 405	1
		Elective	3
	15		**14**

Total Credits 120

ADVISING AND CAREERS

ADVISING AND CAREERS

GENERAL ADVISING

Any student interested in the Atmospheric and Oceanic Sciences or Environmental Sciences major should meet with the Undergraduate Academic Advising Manager listed in the Contact Box on the right sidebar of this page to discuss steps to complete the necessary prerequisite coursework for the major.

CAREER ADVISING

The Department of Atmospheric and Oceanic Sciences encourages majors to begin working on their career exploration and preparation soon after arriving on campus. We partner with SuccessWorks at the College of Letters & Science. L&S graduates are in high demand by employers and graduate programs. It is important that students are career ready at the time of graduation, and we are committed to your success.

L&S CAREER RESOURCES

Every L&S major opens a world of possibilities. SuccessWorks (https://successworks.wisc.edu/) at the College of Letters & Science helps students turn the academic skills learned in their major, certificates, and other coursework into fulfilling lives after graduation, whether that means jobs, public service, graduate school or other career pursuits.

In addition to providing basic support like resume reviews and interview practice, SuccessWorks offers ways to explore interests and build career skills from their very first semester/term at UW all the way through graduation and beyond.

Students can explore careers in one-on-one advising, try out different career paths, complete internships, prepare for the job search and/or graduate school applications, and connect with supportive alumni and even employers in the fields that inspire them.

- SuccessWorks (https://careers.ls.wisc.edu/)
- Set up a career advising appointment (https://successworks.wisc.edu/make-an-appointment/)
- Enroll in a Career Course (https://successworks.wisc.edu/career-courses/) - a great idea for first- and second-year students:
    - INTER-LS 210 L&S Career Development: Taking Initiative (1 credit)
    - INTER-LS 215 Communicating About Careers (3 credits, fulfills Comm B General Education Requirement)
- Learn about internships and internship funding (https://successworks.wisc.edu/finding-a-job-or-internship/)
    - INTER-LS 260 Internship in the Liberal Arts and Sciences
- Activate your Handshake account (https://successworks.wisc.edu/handshake/) to apply for jobs and internships from 200,000+ employers recruiting UW-Madison students
- Learn about the impact SuccessWorks has on students' lives (https://successworks.wisc.edu/about/mission/)

PEOPLE

PEOPLE
PROFESSORS

Back, Larissa
Desai, Ankur (Chair)
Hitchman, Matt
Holloway, Tracey
L'Ecuyer, Tristan
Martin, Jonathan
Morgan, Michael (On leave)
Pierce, Brad
Vimont, Dan

ASSOCIATE PROFESSORS

Adames-Corraliza, Ángel
Lang, Andrea Lopez

ASSISTANT PROFESSORS

Henderson, David
Henderson, Stephanie
Maroon, Elizabeth
Oyola-Merced, Mayra
Rowe, Angela
Wagner, Till

Zanowski, Hannah